long axis of the lumen of the trachea. The exact diameter of this latter should be taken at the height of incision before introducing the canula. In this manner the proper size of the canula can be determined, and the irritation to the mucous membrane, caused by ill-fitting instruments, avoided.

C. J. Colles.

ON THE PRESENT STATE OF KNOWLEDGE IN BACTERIAL SCIENCE AND ITS SURGICAL RELATIONS.

Micro-Organisms and Suppuration.

Since the chapter on suppuration in general (page 150 of this volume) was written, a most valuable contribution to the questions there considered has come to hand, being a prize-essay furnished by George Klemperer, an undergraduate clinical student of the Berlin University, and published in the Zeitschrift für klinische Medicin.[1] The prize had been offered by the faculty in the hope of obtaining some further knowledge leading toward the definite solution of the vexed questions as to the relation of micro-organisms to suppuration, and the contribution under consideration may unhesitatingly lay claim to have elucidated some of the most important points of interest in these questions.

Under the heading above referred to it was concluded from the experimental evidence (Passet), that larger quantities of chemical irritants could produce suppuration even when no bacteria were present; though Scheuerlen had proved that minute quantities (four drops) did not do so. In the present aspect of the subject, however, we are justified in declaring that there can be no suppuration whatever without micro-organisms.

Klemperer considered the precautions taken by previous experimenters (Uskoff, Orthmann, Councilman, Passet,) to prevent the entrance of germs into the tissue-cavity containing the injected chemical substance, to be uncertain and inadequate. He, therefore, adopted a method formerly used by Straus, of Paris, in 1883, consisting in the use of actual cautery to insure the disinfection of the skin and parts surrounding the place of puncture. After producing an eschar of about 2 $^1/_2$ centimetres in diameter with Paquélin's cautery he introduced the canula of the sterilized syringe through the eschar beneath the skin and again occluded this puncture opening with the cautery as soon as the injection was completed. Rabbits, guinea-pigs and mice were thus experimented upon, and the substances injected were, of course, perfectly sterilized. Only in three cases the experiments failed, and pus containing micrococci was found. In all the rest—and a great number were performed—no sign of suppuration was observed, but only inflammatory symptoms were found, occasioning slight serous discharges, or, when potent chemical irritants (oil of turpentine, croton oil, mercury) were used, necroses of the tissues ensued, of the anatomical character of Weigert's coagulation-necrosis. The theorem may be, therefore, considered established, that micro-organisms are the cause of all suppuration.

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[1] Die Beziehung der Micro-organismen zur Eiterung. Gekrönte Preisarbeit. Vol. X. Pp. 158-187.

We subjoin an abstract of the paper as given by the author himself.[1]

1. More or less grave errors can be pointed out in the experiments of such authors who claimed to have produced suppuration after injections of irritant chemical substances with exclusion of micro-organisms. Their results are therefore not correct.

2. Injections of alkalies, organic or inorganic acids never produce suppuration, if micro-organisms be excluded.

3. Cantharides, ol. sinapis, petroleum produce violent inflammation, but no suppuration.

4. Croton oil, oil of turpentine and mercury are to be considered as producing the most intense inflammations. Injection of small amounts of these substances produces serous inflammation, if micro-organisms be absolutely excluded.

5. Larger amounts of oil of turpentine and croton oil in oily solutions, and mercury, produce coagulation-necrosis (Weigert) and fibrinous inflammation.

6. Injections of large amounts of turpentine and croton oil in alcoholic solutions produce serous inflammation, on account of the more rapid absorption.

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[1] Centralblatt für Chirurg. 1885. No. 51.

7. Only in case micro-organisms enter under the skin after injections of turpentine, croton oil, and mercury, does suppuration occur. Micrococci can be observed in the pus in these cases, and they may be artificially cultivated, if they be inoculated into the soils before they lose their vitality.

To these results of his experience the author adds the following theoretical deductions:

8. Suppuration is occasioned by a quantitative as well as a qualitative alteration of the inflammatory process. The quantitative difference consists in the increased extravasation of white blood-corpuscles, as well as in the tendency of the process to spread, and in the general disturbance of the system frequently observed. The qualitative alteration consists in the purulent exudate remaining fluid, although all the substances necessary to the formation of fibrin are at first undoubtedly present.

9. Both these alterations in the character of the exudate in purulent as compared to other inflammations, are to be accounted for by the vital characteristics of the micrococci:

(*a*.) Quantitative alterations. The increased emigration of leucocytes and the general disturbance of bodily function is to be explained by means of the phlogogenic or poisonous secretions or products of the cocci. The progressive tendency is due to the advance of the cocci along the vessels, etc.

(*b*.) Qualitative changes. The fact that the pus fails to coagulate is occasioned by the want of fibrinogenic substance (one of the three generators of fibrin). This substance is probably converted into peptone by the cocci. That the latter can peptonize certain fluids has been proved as well as that pus contains peptone.

These latter considerations (Nos. 8 and 9) will, of course, be considered only in the light of ingenious hypotheses,[1] which future investigations will establish or refute. But it is not probable that the maxim advanced in this paper that micro-organisms are the cause of all suppuration will be again called in question in future.

[1] The idea that peptone plays a part in purulent inflammation has been suggested by Landerer. Cf. this journal. Vol. II. P. 485.

Weigert[1] and Councilman[2] have previously pointed out that since the introduction of chemical irritants into the animal body does not occur outside of the pathological laboratories, it suffices for all purposes of practice to say that no suppuration occurs unless through the action of micro-organisms. This theorem is therefore not altogether new. But still, as long as we are under the necessity of explaining the toxic effects of septicæmic poisoning, etc., by means of hypothetical products of the micro-organisms, it appears natural to ascribe the phenomenon that pus does not coagulate. not so much to the mere presence of the micrococci in purulent inflammations, but to some chemical product of their vitalistic energies, which may possibly some day be artificially compounded in our laboratories, as Friedländer points out,[3] after the cultivation-soils of such micrococci have been properly submitted to chemical analysis.

If we, however, accept the dogma that there can be no suppuration without micro-organisms, we must attribute all so-called eliminating suppurations, as in cases of necrosis, to the presence of micro-organisms as well, and not to mere lifelessness of tissue. This it appears natural to do since we know that osteomyelitis, acute periostitis, etc. are actually caused by micrococci. If no micro-organisms are present the necrotic portions of bone, etc., are absorbed, and dead tissues disappear by regressive metamorphosis without suppuration.

It might be objected that cold abscesses are known to contain no micrococci. But the chronic inflammatory conditions which lead to cold abscesses are all of a closely allied nature, and contain, if not micrococci, tubercle-bacilli—even though the latter have not always been found in the pus.[4]

As to the forms of micro-organisms found by Klemperer in his experiments, he distinguishes three kinds according to the effects which they produce. One kind is said to occasion only inflammation, another suppuration from the first, while a third variety possesses the property of converting existing inflammation into suppuration.

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[1] Forstchritte der Medicin. Vol. I. P. 661.

[2] Virchow's Arch. Vol. XCII. P. 217.

[3] Fortschritte der Medicin. Vol. IV. P. 35.

[4] G. Geisler, Jahrb. f. Kinderheilk. Vol. XXIII. P. 37.

MICRO-ORGANISMS AND HEALTHY TISSUES.

The question whether micro-organisms are not sometimes present in healthy tissues has likewise been again thoroughly investigated in an experimental work by G. Hauser, of Erlangen,[1] with the result, which was to be expected after Koch's researches on the same subject, that micro-organisms do not occur in the tissues of healthy animals.

In our article on sepsis (page 321 of this volume) reference is made to the experiments of Rosenberger, Rossbach and Zweifel, who concluded that micro-organisms were present in healthy tissues. Hauser commences his article by refuting these views and separately demonstrates in detail how they all are based upon experiments performed with insufficient antiseptic precauticns, which are therefore not convincing.

The experiments consisted principally in procuring substances prone to fermentation as parts of organs, blood, urine, etc., in a pure condition and preserving them unfermented for long periods of time, simply by protecting them from infection, by means of simple cleanliness (sterilized apparatus), not by disinfectants. He preserved the substances in rarified air, in atmospheric air filtered through cotton, in hydrogen, oxygen, and carbonic acid gas, in water, and in various artificial culture-soils, all under the most favorable conditions for putrefaction—but without any such action occurring. In this manner he could positively prove that living tissues of animals contain no bacteria or germs of micro-organisms whatever; since it is well known that the slightest contamination with substances containing such microbes makes it impossible to preserve organic matter from fermentation and putrefaction. Besides the observation that living tissues contained no micro-organisms the author found that the preserved organs in time underwent a sort of regressive metamorphosis similar to that which takes place in the body in the absence of micro-organisms, and, what is of especial interest, that the products of such processes of resolution possess no poisonous properties whatever.

W. W. VAN ARSDALE.

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[1] Ueber das Vorkommen von Micro-org. im lebenden Gewebe gesunder Thiere Arch. f. experiment. Pathol. u. Pharm. Vol. XX. Pp. 162-202.